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(72) Inventors FRANCIS WILLIAM WOOD and ROBERT YOUNG

(19)

(54) FRUIT-LIKE FOOD PRODUCT

(71) We, UNILEVER LIMITED, a company organised under the laws of Great Britain, of Unilever House, Blackfriars, London E.C.4, England, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for the preparation of simulated fruit, which fruit can, for example, be incorporated, as natural fruit pieces are, in dessert products such as fruit pies or flans or in dairy products such as yoghurt.

The present invention provides a process for preparing simulated fruit in which a mixture is made rapidly comprising an alginate or a low methoxy pectate sol, a source of calcium ions that in the absence of an agent capable of releasing calcium ions provides insufficient calcium ions to gel the sol, fruit pulp or puree and an agent capable of releasing calcium ions and the mixture is allowed to gel under substantially shear-free conditions.

To obtain a product with a uniform gel strength, the calcium ions which gel the alginate or pectate sol should be uniformly distributed throughout it. In a preferred procedure there is first prepared a mixture of alginate or low methoxy pectate sol and a calcium compound having insufficient free calcium ions to gel the alginate or pectate, and the mixture is rapidly mixed with fruit pulp or like material and an agent capable of releasing calcium ions from the calcium compound; the sol is gelled by the calcium ions thus liberated.

A preferred source of calcium ions are calcium compounds which are substantially insoluble under neutral conditions but which become soluble under acid conditions, such as normal calcium citrate, $CaHPO_4$ and normal calcium tartrate. The agent used to release the calcium ions is then an acid, preferably a naturally occurring organic acid such as citric acid, malic acid, lactic acid, tartaric acid or fumaric acid.

In a procedure alternative to that just described, the fruit material, with the source of calcium ions, is distributed throughout the alginate or pectate sol before the sol is mixed with the calcium-ion release agent.

In either procedure, an edible calcium-complexing agent such as trisoduim citrate is preferably included in the mixture which is gelled to ensure a controlled release of calcium ions on the bringing together of the insoluble calcium compound and the acidic calcium-ion release agent.

The fruit pulp or puree used is obtanied by any procedure which, while destroying the structure of the fruit as such, so as to release from the fruit structure the juice which it encloses, nevertheless stops well short of destroying all the structural elements of the fruit, for the presence of such elements is required in order to impart to the desired product the appropriate fruit-simulating texture. Fruits which when cut into slices or chunks have a relatively uniform texture, such as apple, pear, peach and apricot can be imitated more closely than fruits such as raspberries and citrus fruits. To obtain products simulating fruits of the first kind, fruit purees can be used; whereas to obtain products simulating raspberries for example, it is best to employ the raspberry waste or pulp left when raspberries are lightly crushed to expel the greater part of the juice, leaving otherwise intact the cell sacs from which the juice has been expressed.

The proportion of fruit material used to form the simulated fruit can be varied within wide limits. A fruit puree is preferably used in an amount forming at least 25% by weight of the simulated fruit. Material containing a high proportion of the solids of the fruit, such as the pulp remaining after pressing out of fruit juice, can be used at a somewhat lower level. When the lower levels of fruit material are used flavouring and colouring agents are preferably incorporated in the simulated fruit.

The alginate or pectate used to form the

product of the invention is preferably sodium alginate of high molecular weight (of the order of 100,000). Alginates having a low content of mannuronic acid residues (mannuronic: guluronic ratio less than 1:1) are specially suitable. A simulated fruit product based on such alginates is claimed in co-pending patent application 04352/74 (Serial No. 1369199), divided out of the present application. The proportion of alginate or pectate used varies with its gelling ability (that is, the gel strength obtained per unit weight) and with the texture desired in the final product. We have found that when the preferred sodium alginate is used it suitably forms from 0.4% to 2% by weight of the simulated fruit to be formed.

In carrying out the invention, it is important that the mixture of alginate or pectate sol and other ingredients should be allowed to gel under the action of calcium ions while in a shear-free condition. Gel formation is to be avoided in any mixing apparatus used or in any pipes through which the mixture passes *en route* to the moulds in which gelation is to proceed. When carrying out the process of the invention, mixing of the sol and the source of the calcium ions with the calcium-ion-release agent should be as rapid as possible. We have observed that if a solution containing free calcium ions is mixed with the alginate or pectate sol, the gelling reaction between the calcium ions and the alginate or low methoxy pectate proceeds so fast that the calcium cannot be distributed throughout the alginate or pectate before considerable gelling has taken place, with the result that a gel of very uneven texture is formed. Gelation is considerably slower in the system employed when carrying out the present invention, particularly where the onset of gelling is delayed by including in the system an edible calcium-complexing agent, such as trisodium citrate. By thus controlling the concentration of free calcium ions, it is possible without detriment to the texture of the final product to allow some 2 minutes to elapse from the moment of first contact (i.e. in the mixer) between the alginate or pectate sol and the calcium-ion-release agent to the time at which the mixture reaches a substantially shear-free condition in the moulds in which gelation is to proceed. The preferred type of mixer is an in-line mixer having a low volume, a low residence time and a high shear rate and no back mixing.

So as not to risk premature gelation, it is desirable to use a freshly prepared mixture of alginate or pectate sol and the required calcium compound; a mixture that has been standing for an hour or more will gel much faster than a sol to which the calcium compound has been freshly added. It is preferable to prepare the mixture continuously, so that it is of constant age when contacted with the calcium-ion-release agent.

In forming the initial mixture of alginate or pectate sol and calcium compound, aeration is best avoided, so as to avoid formation of an end-product which is aerated. A suitable mixer for this prior mixing step is a baffled turbine mixer; and mixing can be carried out under vacuum if desired.

At the stage of gelation, moulds can be used from which imitation fruit pieces can be cut in a desired shape. For certain simulated fruits, such as raspberries and strawberries, small indivdual moulds having a shape similar to that of natural fruit can be used. Alternatively continuous moulds passing on a conveyor system under the mixer outlet can be used. These can be rectangular moulds, in which case shaped pieces can be cut from the block of gel formed; or they can be elongated moulds, in which case the rods of gel formed can be cut at angles to their length. This latter method is preferred when making apple, peach or apricot segments.

In an alternative method of shaping suitable for forming simulated cherries, the apparatus described in the specification and drawings of British Patent Specification 727,475 can be used to extrude the incipiently gelling mixture of sol, calcium ions and fruit material into a bath of support liquid, which may contain calcium ions. In this procedure, the calcium ions in the bath quickly form a gelled skin on the simulated cherries, while the calcium ions incorporated in the sol ensure that the simulated cherries becomes gelled throughout.

In addition to the ingredients already mentioned, others can be included to enhance the properties of the simulated fruit and to make it more closely resemble natural fruit. Sugar is generally used, and at least part of any sugar used is preferably incorporated at the stage of making the alkinate or pectate sol, since it aids the dispersion of the sodium alginate or low methoxy pectate.

A small proportion, for example up to 0.2% of locust beam gum can be incorporated into the simulated fruit. This gives the product a less jelly-like and more fruit-like texture and a more opaque appearance.

Spray-dried fat can be incorporated in the simulated fruit when the fruit used is one which naturally has a creamy texture, such as banana or avocado pear.

As stated earlier, the preferred method of releasing calcium ions in the alginate or pectate sol is by the action of an acid on a calcium compound which is insoluble under neutral conditions, but soluble to some extent at an acidic pH. If for this purpose fruit acid such as citric acid or malic acid is used, and used in excess, the simulated fruit formed has a tartness resembling that of natural fruit. We have found that the amount of acid present influences the texture of the simulated fruit; a high proportion of acid leads to a firmer texture. However, the presence of a salt such as sodium citrate tends to produce a softer

texture. Accordingly, by varying the amounts of the organic acid and sodium citrate present, the firmness and tartness in the simulated fruit may be varied. The proportion of the organic acid in the fruit is preferably 0.5 to 1.5% by weight. If a high level of acid is used special care should be taken to avoid premature gelation.

The calcium alginate or pectate gels of the products of the invention are not unduly heat-reversible. When an alginate of low mannuronic acid content is used, the gel is sufficiently heat-stable to withstand canning or baking. The simulated fruits exhibit some syneresis on freezing and thawing. While a small amount of syneresis may be acceptable as giving the fruit a slightly moist texture, it is preferably to include a freeze-thaw stabilising agent in the simulated fruit when it is to be used in frozen products. The preferred freeze-thaw stabilising agent is a cooked starch such as pre-cooked potato starch, which can be used at a level of 1 to 5%, preferably 1 to 2%. Alternatively sodium carboxymethyl cellulose or a non-ionic cellulose ether, such as methyl cellulose or ethyl cellulose can be used. For fruits such as strawberry, a simulated fruit can be formed which retains its texture on freezing and thawing better than the natural fruit. With some simulated fruits such as banana, a cooked starch such as cooked cornflour may be incorporated in the simulated fruit to improve its texture, whether or not the fruit is to be frozen.

The proportion of the ingredients used can be varied to obtain products of different gel strengths. For example, the gel strength (as measured on a Bloom gelometer) of simulated apple pieces for use in a pie is preferably made to be from 80 to 200 g particularly from 110 to 180 g, that of simulated strawberry pieces for inclusion in yogurt from 40 to 80 g, and that of simulated mandarin pieces from 50 to 100 g. The minimum gel strength of a food product according to the invention is in practice about 30 g.

Particularly suitable applications of the simulated fruit are in fruit pies and flans, which can be frozen or not, in dairy products such as yoghurt, quark, mousse and ice cream, in canned fruit products, particularly those sold as fillings for pies, flans and crumbles, and in jams and fruit sauces to provide distinctive fruit pieces. The simulated fruit can be pasteurised (conveniently by steam heating) whilst it is setting, but freezing is to be avoided until setting is substantially complete.

The following Examples illustrate the preparation of self-supporting gel products from a variety of fruit materials.

EXAMPLE 1

An alginate sol containing a calcium compound having insufficient free calcium ions to gel the alginate was prepared from the following ingredients:

	Parts by weight
Sodium alginate	1.26
Dicalcium phosphate	0.31
Trisodium citrate ($C_6H_5O_7Na_3 . 2H_2O$)	1.12
Castor sugar	9.7
Water	37.6

The sodium alginate, dicalcium phosphate, sodium citrate and sugar were mixed together in a dry state in a powder and were then dispersed in water to form a sol in a continuous baffled turbine mixer.

An apple puree mix containing citric acid (which is capable of releasing calcium ions from the calcium compound included in the above sol) was prepared by mixing the following ingredients in a conventional batch mixer.

	Parts by weight
Apple puree	37.6
Citric acid	1.20
Locust bean gum	0.10
Granulated sugar	9.7
Pre-cooked potato starch	1.4

The alginate sol and the fruit puree mix were separately pumped each at a flow rate of 68.0 Kg per hour to a low residence time, high shear continuous in-line mixer such as an Oakes 4M mixer. The resulting mixture was passed through a small distributor into a set of elongated moulds of semi-circular cross-section carried along on a conveyor belt. The time between the mixing of the alginate sol with the fruit puree mix and the emergence of the mixture from the distributor was less than 30 seconds, and practically no gelation of the mixture had taken place during this time. The mixture was allowed to gel in a shear-free condition whilst in the moulds to form semi-circular rods of calcium alginate gel having fruit puree uniformly distributed throughout it. The rods were cut into apple segment shapes, and these were then frozen and incorporated in a frozen pie. When the pie was thawed and cooked the apple piece were found to have a texture very similar to that of cooked natural apple pieces. The apple puree used in this Example was obtained by cooking apples and then comminuting and sieving them (1/16" sieve).

EXAMPLE 2

An alginate sol was prepared following generally the procedure of Example 1 from the following ingredients:

	Parts by weight
Sodium alginate	0.56
Dicalcium phosphate	0.14
Trisodium citrate	0.64
Castor sugar	10.8
Water	37.8

A fruit pulp mix was prepared generally as described in Example 1 from the following ingredients:

	Parts by weight
Strawberry pulp	40.2
Citric acid	1.20
Locust bean gum	0.10
Granulated sugar	8.4
Strawberry flavour	0.16

The alginate sol and the fruit pulp mix were then pumped, each at a flow rate of 68.0 Kg per hour, to an Oakes 4M mixer. The resulting mixture was passed through a small distributor onto a flat conveyor belt with side walls. This belt formed a mould in which the mixture could gel under shear-free conditions. The time spent in the mixer and distributor was less than 30 seconds and practically no gelation took place during that time. The mixture was pasteurised whilst gelation was taking place. When gelation was substantially complete a sheet of calcium alginate gel having strawberry pulp uniformly distributed throughout it was obtained and this sheet was cut into small simulated strawberry pieces, having a texture very similar to that of pieces of natural strawberries. They were suitable for incorporation in a fruit yoghurt. If 1.5% of a pre-cooked starch (based on the total ingredients) is included in the strawberry pulp, simulated strawberry pieces suitable for inclusion in frozen products are obtained.

EXAMPLE 3

An alginate sol was prepared from the following ingredients generally as described in Example 1:

	Parts by weight
Sodium alginate	1.16
Dicalcium phosphate	0.19
Trisodium citrate	0.54
Castor sugar	8.1
Water	35.0
Pre-cooked potato starch	4.5
Spray-dried fat	5.4

A banana puree mix was prepared as described in Example 1 from the following ingredients:

	Parts by weight
Banana puree	35.0
Malic acid	0.51
Ascorbic acid	0.10
Locust bean gum	0.10
Granulated sugar	9.4

The alginate sol and the fruit puree mix were then separately pumped to an Oakes 4M mixer. The sol was pumped at a flow rate of 61.0 Kg per hour. The mixture formed was passed through a small distributor onto a belt with raised edges as described in Example 2. The time spent by the mixture in the mixer and distributor was less than 30 seconds and no substantial gelation took place during this time. The mixture was pasteurised whilst gelation was taking place and after gelation was substantially complete the resulting sheet of calcium alginate gel having fruit puree distributed throughout it was cut into small pieces. The simulated banana pieces formed had a texture very similar to that of natural banana pieces.

EXAMPLE 4

An alginate sol was prepared following generally the procedure of Example 1 from the following ingredients:

	Parts by weight
Sodium alginate	0.75
Dicalcium phosphate	0.21
Trisodium citrate	0.89
Pree-cooked potato starch	0.10
Locust bean gum	0.10
Sugar	11.4
Water	36.55

A fruit pulp mix was prepared generally as described in Example 1 from the following ingredients:

	Parts by weight
Apricot pulp	37.7
Sugar	7.8
Citric acid	1.20
Colouring and flavouring agents	0.45
Water	2.85

The alginate sol and the fruit pulp mix were then pumped each at a flow rate of 68.0 Kg per hour to an Oakes 4M mixer. The resulting mixture was passed through a small distributor to a series of individual hemispherical moulds. The mixture was allowed to gel in these moulds under shear-free conditions. The time spent in the mixer and distributor was less than 30 seconds and practically no gelation took place during that time. When gelation was substantially complete, simulated apricot halves comprising calcium alginate gel having apricot pulp uniformly distributed throughout it were obtained. These simulated apricot halves were canned in syrup and sterilised using a hot fill procedure and the resulting product had a texture resembling that of canned apricots.

EXAMPLE 5

A low methoxy pectate sol containing insufficient free calcium ions to gel the pectate was prepared from the following ingredients by first mixing the low methoxy pectate, dicalcium phosphate, sodium citrate and sugar

in a dry state and then dispersing these in water.

	Parts by weight
Sodium low methoxy pectate	2.0
Dicalcium phosphate	0.35
Trisodium citrate	0.5
Sugar	13.3
Water	33.85

An apple puree mix containing citric acid was prepared by mixing the following ingredients in a conventional batch mixer:

	Parts by weight
Apple puree	40.0
Sugar	5.0
Citric acid	1.2
Water	3.8

The low methoxy pectate sol and the apple puree mix were then mixed in a bowl, using vigorous stirring with a hand mixer for 30 seconds. During this time no substantial gelation took place. The mixture was then allowed to gel, and a calcium low methoxy pectate gel having apple puree uniformly distributed throughout it was was formed. This gel was found to have the texture of canned apple segments.

WHAT WE CLAIM IS:—

1. A process for preparing simulated fruit in which a mixture is made rapidly comprising an alginate or a low methoxy pectate sol, a source of calcium ions that in the absence of an agent capable of releasing calcium ions provides insufficient calcium ions to gel the sol, fruit pulp or puree and an agent capable of releasing calcium ions and the mixture is allowed to gel under substantially shear-free conditions.

2. A process as claimed in Claim 1 in which a preliminary mixture is made of the sol and the source of calcium ions and the preliminary mixture is rapidly mixed with the fruit pulp or puree and the calcium-ion-release agent.

3. A process as claimed in Claim 1 in which a preliminary mixture is made comprising the sol, the fruit pulp or puree and the source of calcium ions and the preliminary mixture is rapidly mixed with the calcium-ion-release agent.

4. A process as claimed in Claim 2 or Claim 3 in which the preliminary mixture contains an edible calcium-complexing agent.

5. A process as claimed in Claim 4 in which the complexing agent is sodium tricitrate.

6. A process as claimed in any one of claims 1 to 5 in which the source of calcium ions is a calcium salt substantially insoluble under neutral conditions but soluble under acid conditions and the calcium-ion-release agent is an acid.

7. A process as claimed in Claim 6 in which the calcium salt is normal calcium citrate, dicalcium phosphate or normal calcium tartrate.

8. A process as claimed in Claim 6 or Claim 7 in which the acid is citric, malic, lactic, tartaric or fumaric.

9. A process as claimed in any one of claims 1 to 7 in which the amount of alginate, calculated as sodium alginate, in the simulated fruit is, by weight, 0.5 to 2%.

10. A process as claimed in any one preceding claim in which the mixture contains locust bean gum.

11. A process as claimed in any one preceding claim in which the mixture contains a freeze-thaw stabilising agent.

12. A process as claimed in Claim 11 in which the freeze-thaw stabilising agent is a pre-cooked starch.

13. A process as claimed in any one preceding claim in which the mixture contains apple puree.

14. A process as claimed in any one preceding claim in which the mixture contains strawberry pulp.

15. A process as claimed in any one preceding claim in which the mixture contains apricot pulp.

16. A process as claimed in Claim 1 substantially as described with particular reference to Example 5.

17. A process as claimed in any one of claims 1 to 15 in which the mixture contains alginate in which the ratio of mannuronic acid residues to guluronic acid residues is less than 1:1.

18. A process as claimed in Claim 1 substantially as described with particular reference to any one of Examples 1 to 4.

19. A simulated fruit prepared by a process as claimed in any one of Claims 1 to 16.

20. A composite food product, such as a pie, flan, dairy product or jam, incorporating a simulated fruit as claimed in Claim 19.

J. M. REID,
Chartered Patent Agent.

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